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## (54) REFRIGERATOR WITH DUCT SYSTEM TO PROVIDE COLD AIR FROM A FREEZER COMPARTMENT EVAPORATOR TO AN ICE MAKER

(57) A refrigerator (10) includes a cabinet structure (13) having a refrigerator compartment (12) and a freezer compartment (24). An evaporator (80) is positioned in the freezer compartment (24) within an evaporator housing (64). A door (18) is pivotally coupled to the cabinet structure (13) for selectively providing access to the refrigerator compartment (12) and includes an ice maker (30). A duct assembly (70) includes an ice maker feed duct (72) operably coupled to the evaporator housing (64) at a first end (74), and further coupled to the ice maker (30) at a second end (76). The duct assembly (70) further includes an ice maker return duct (82) operably coupled to the ice maker (30) at a first end (74) and further coupled to the evaporator housing (64) at a second end (76). First and second fans (100, 102) are provided in-series, wherein the first fan (100) provides cooled air to the freezer compartment (24), and the second fan (102) provides cooled air from the first fan (100) to the ice maker (30) during an ice making cycle.

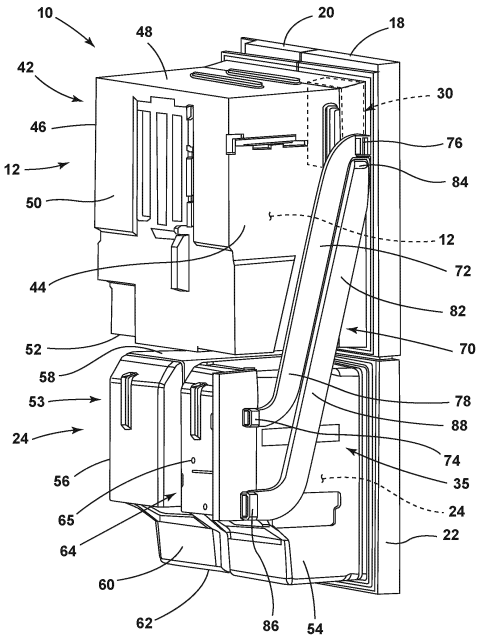


FIG. 2

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## Description

### BACKGROUND OF THE DISCLOSURE

**[0001]** The present concept generally relates to a refrigeration device, and more particularly, to a refrigeration device in the form of a refrigerator having conduits directing cooled air from the freezer compartment to an ice maker disposed in a refrigerator door.

**[0002]** Duct systems in a refrigerator can be complex non-linear systems that lead to increased negative pressure in a freezer compartment which can lead to frost buildup in the freezer compartment due to ambient air infiltration. This is particularly noticeable when a duct system includes both a cabinet duct system and a door duct system that interconnect to provide cold air to an ice maker. The present concept provides a directly routed duct system to help equalize pressure and reduce ambient air infiltration.

### SUMMARY OF THE DISCLOSURE

**[0003]** According to one aspect of the present disclosure, a refrigerator includes a cabinet structure having a refrigerator compartment and a freezer compartment. An evaporator is positioned in the freezer compartment within an evaporator housing. A door is pivotally coupled to the cabinet structure for selectively providing access to the refrigerator compartment. The door includes an ice maker operably coupled to the door for pivoting movement therewith. A duct assembly includes an ice maker feed duct that is operably coupled to the evaporator housing at a first end and further coupled to the ice maker at a second end. The duct assembly further includes an ice maker return duct operably coupled to the ice maker at a first end and further coupled to the evaporator housing at a second end.

**[0004]** According to another aspect of the present disclosure, a refrigerator includes a cabinet structure having a refrigerator compartment, a freezer compartment and at least one sidewall with an interior cavity. An evaporator housing is positioned within the freezer compartment and includes first and second portions. An evaporator is positioned within the first portion of an evaporator housing. A duct assembly includes an ice maker feed duct operably coupled to the second portion of the evaporator housing at a first end and further coupled to an ice maker disposed above the freezer compartment at a second end. The duct assembly further includes an ice maker return duct operably coupled to the ice maker at a first end and further coupled to the first portion of the evaporator housing at a second end. The ice maker feed duct and the ice maker return duct include substantially linear body portions disposed within the interior cavity of the at least one sidewall of the cabinet structure.

**[0005]** According to yet another aspect of the present disclosure, a refrigerator includes first and second fans each having a first side and a second side. The first and second fans are arranged in-series with the second side of the first fan fluidically coupled to the first side of the second fan by an inlet. An evaporator is disposed within a freezer compartment and fluidically coupled to the first side of the first fan. An ice maker is disposed outside of the freezer compartment and fluidically coupled to the second side of the second fan by an ice maker feed duct. An ice maker return duct is fluidically coupled between the ice maker and the evaporator.

**[0006]** These and other features, advantages, and objects of the present disclosure will be further understood and appreciated by those skilled in the art by reference to the following specification, claims, and appended drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0007]** In the drawings:

FIG. 1 is a top front perspective view of a refrigerator;
FIG. 2 is a top rear perspective view of the refrigerator of FIG. 1 with an exterior wrapper removed to reveal a refrigerator compartment, a freezer compartment, an ice maker, an evaporator housing and a duct assembly;
FIG. 3 is a top front perspective view of the duct assembly of FIG. 2 as coupled to the ice maker and disposed within a sidewall shown in phantom;
FIG. 4 is a rear elevation view of the refrigerator of FIG. 1 with a rear wall of the exterior wrapper removed;
FIG. 5 is a side top perspective view of the duct assembly of FIG. 3;
FIG. 6 is a top perspective view of the evaporator housing of FIG. 2;
FIG. 7 is a schematic illustration of an evaporator housing connected to a freezer compartment and further connected to an icemaker via a duct assembly;
FIG. 8 is a front elevation view of the ice maker of FIG. 3; and
FIG. 9 is a top perspective view of the evaporator housing of FIG. 6.

### DETAILED DESCRIPTION

**[0008]** The present illustrated embodiments reside primarily in combinations of method steps and apparatus components related to a duct and fan assembly for a refrigerator. Accordingly, the apparatus components and method steps have been represented, where appropriate, by conventional symbols in the drawings, showing only those specific details that are pertinent to understanding the embodiments of the present disclosure so as not to obscure the disclosure with details that will be readily apparent to those of ordinary skill in the art having the benefit of the description herein. Further, like numerals in the description and drawings represent like ele-

ments.

**[0009]** For purposes of description herein, the terms "upper," "lower," "right," "left," "rear," "front," "vertical," "horizontal," and derivatives thereof shall relate to the disclosure as oriented in FIG. 1. Unless stated otherwise, the term "front" shall refer to the surface of the element closer to an intended viewer, and the term "rear" shall refer to the surface of the element further from the intended viewer. However, it is to be understood that the disclosure may assume various alternative orientations, except where expressly specified to the contrary. It is also to be understood that the specific devices and processes illustrated in the attached drawings, and described in the following specification are simply exemplary embodiments of the inventive concepts defined in the appended claims. Hence, specific dimensions and other physical characteristics relating to the embodiments disclosed herein are not to be considered as limiting, unless the claims expressly state otherwise.

**[0010]** The terms "including," "comprises," "comprising," or any other variation thereof, are intended to cover a non-exclusive inclusion, such that a process, method, article, or apparatus that comprises a list of elements does not include only those elements but may include other elements not expressly listed or inherent to such process, method, article, or apparatus. An element proceeded by "comprises a ... " does not, without more constraints, preclude the existence of additional identical elements in the process, method, article, or apparatus that comprises the element.

**[0011]** Referring to the embodiment illustrated in FIG. 1, reference numeral 10 generally designates a refrigerator having a cabinet structure 13 with a front surface 14 opening into a refrigerator compartment 12. The cabinet structure 13 may include a vacuum insulated cabinet structure, as further described below. The refrigerator compartment 12 is contemplated to be an insulated portion of the cabinet structure 13 for storing fresh food items. First and second doors 18, 20 are rotatably coupled to the cabinet structure 13 near the front surface 14 thereof for selectively providing access to the refrigerator compartment 12 by pivoting movement between open and closed positions. In the embodiment shown in FIG. 1, a freezer drawer 22 is configured to selectively provide access to a freezer compartment 24 disposed below the refrigerator compartment 12. The refrigerator 10 shown in FIG. 1 is an exemplary embodiment of a refrigerator for use with the present concept, and is not meant to limit the scope of the present concept in any manner.

**[0012]** As further shown in FIG. 1, the first door 18 includes a dispensing station 2 which may include one or more paddles 4, 6 which are configured to initiate the dispensing of water and/or ice from outlets disposed within the dispensing station 2. In the embodiment shown in FIG. 1, the dispensing station 2 is shown as being accessible from outside of the refrigerator 10 on an exterior portion of the first door 18, but may also be provided along any portion of the refrigerator 10, including an interior of the refrigerator compartment 12, for dispensing ice and/or water. The dispensing station 2 is contemplated to be coupled to an ice maker 30 which is shown in phantom in FIG. 1. It is contemplated that the ice maker 30 may be operably coupled to the first door 18 to pivotally move with the first door 18 between open and closed positions. Further, it is contemplated that the ice maker 30 may be fixedly positioned within the refrigerator compartment 12. As further shown in FIG. 1, the cabinet structure 13 of the refrigerator 10 includes an exterior wrapper 32 which includes first and second sidewalls 34, 36, a top wall 38 and a rear wall 40. The exterior wrapper 32 is contemplated to be a metal component formed of a sheet metal material.

**[0013]** Referring now to FIG. 2, the refrigerator 10 is shown with the cabinet structure 13 removed to reveal the refrigerator compartment 12 disposed over the freezer compartment 24. The refrigerator compartment 12 is generally defined by a refrigerator liner 42 which includes first and second sidewalls 44, 46, a top wall 48, a rear wall 50 and a bottom wall 52. The freezer compartment 24 also includes a freezer liner 53 having first and second sidewalls 54, 56, a top wall 58, a rear wall 60 and a bottom wall 62. The refrigerator liner 42 and freezer liner 53 may be comprised of a sheet metal material or a polymeric material. As encapsulated by the exterior wrapper 32, the refrigerator liner 42 and the freezer liner 53 are spaced-apart from the exterior wrapper 32 to define an insulating space 66 (FIG. 4) therebetween, which may include a vacuum insulated space. Thus, the exterior wrapper 32 and the refrigerator liner 42 and freezer liner 53 may be interconnected by a trim breaker to define the overall cabinet structure 13 of the refrigerator 10.

**[0014]** With further reference to FIG. 1, the cabinet structure 13 includes first and second sidewalls 13A and 13B. The first sidewall 13A of the cabinet structure 13 is comprised of the first sidewall 34 of the exterior wrapper 32 as spaced-apart from the first sidewall 44 of the refrigerator liner 42 and the first sidewall 54 of the freezer liner 53. With the first sidewall 34 of the exterior wrapper 32 spaced-apart from the first sidewall 44 of the refrigerator liner 42 and spaced-apart from the first sidewall 54 of the freezer liner 53, an interior cavity 68 (FIGS. 3 and 4) of the first sidewall 13A is defined therebetween. The interior cavity 68 of the first sidewall 13A of the cabinet structure 13 is part of the insulating space 66 (FIG. 4) surrounding the refrigerator liner 42 and the freezer liner 53 and that is further surrounded or encapsulated by the exterior wrapper 32. It is contemplated that the second sidewall 13B is similarly formed on an opposite side of the cabinet structure 13 relative to the first sidewall 13A. In FIGS. 3 and 4 the combination of the first sidewall 44 of the refrigerator liner 42 and the first sidewall 54 of the freezer liner 53 is represented by reference numeral 35 for ease in defining the parameters of the first sidewall 13A of the cabinet structure 13.

**[0015]** With further reference to FIG. 2, an evaporator housing 64 is shown disposed on or adjacent to the rear

wall 60 of the freezer liner 53. The evaporator housing 64 houses an evaporator 80 (FIG. 4) that provides cold air to the freezer compartment 24 and the ice maker 30. In FIG. 2, the evaporator 80 is concealed by an evaporator housing cover 65. It is contemplated that cold air may be drawn from the evaporator housing 64 for cooling the refrigerator compartment 12 as well. The first sidewall 13A (FIG. 1) is positioned on the same side of the cabinet structure 13 as the ice maker 30 and the evaporator housing 64. As positioned on this side of the cabinet structure 13, the interior cavity 68 of the first sidewall 13A houses a duct assembly 70 that interconnects the ice maker 30 and an evaporator housing 64. The duct assembly 70 is configured to be concealed within the interior cavity 68 of the first sidewall 13A, as best shown in FIG. 3. The duct assembly 70 includes an ice maker feed duct 72 having first and second ends 74, 76 with a body portion 78 disposed therebetween. The body portion 78 is a substantially liner body portion that defines an ascending airway between the evaporator housing 64 and the ice maker 30. The duct assembly 70 further includes an ice maker return duct 82. The ice maker return duct 82 includes a first end 84 coupled to the ice maker 30, and a second end 86 coupled to the evaporator housing 64. The ice maker return duct 82 further includes a body portion 88 disposed between the first and second ends 84, 86 that defines substantially linear descending airway between the ice maker 30 and the evaporator housing 64. As used herein, the terms "substantial," "substantially," and variations thereof are intended to note that a described feature is equal or approximately equal to a value or description. For example, a "substantially linear" feature is intended to denote a feature that is linear or approximately linear. Moreover, "substantially" is intended to denote that two values are equal or approximately equal. In some embodiments, "substantially" may denote values within about 10% of each other, such as within about 5% of each other, or within about 2% of each other. As such, the substantially linear body portions 78, 88 of the ice maker feed duct 72 and the ice maker return duct 82, respectively, are contemplated to be substantially straight or linear body portions that interconnect the evaporator housing 64 with the ice maker 30 in a direct and un-convoluted manner.

**[0016]** Referring now to FIG. 3, the duct assembly 70 is shown disposed within the interior cavity 68 of the first sidewall 13A of the cabinet structure 13. As configured in FIG. 3, the ice maker feed duct 72 and the ice maker return duct 82 of the duct assembly 70 are entirely disposed within the interior cavity 68 of the first sidewall 13A of the cabinet structure 13. The first sidewall 13A is shown in phantom in FIG. 3 to better illustrate the position of the duct assembly 70 within the interior cavity 68 of the first sidewall 13A. Thus, the duct assembly 70, including ice maker feed duct 72 and the ice maker return duct 82, is disposed within a single sidewall, the first sidewall 13A, of the cabinet structure 13. This configuration helps to directly feed cold air from the evaporator housing 64 to the ice maker 30. In FIG. 3, the evaporator housing cover 65 (FIG. 2) has been removed from the evaporator housing 64 to reveal first and second portions 64A, 64B of the evaporator housing 64. In the second portion 64B of the evaporator housing 64, the evaporator 80 (FIG. 4) is disposed and concealed in the view of FIG. 3 by an evaporator plate 81. In the first portion 64A of the evaporator housing 64, first and second fans 100, 102 are shown. The first fan 100 is configured to feed cold air to the freezer compartment 24 during a freezer compartment cooling cycle. As such, the first fan 100 may be referred to herein as a freezer compartment fan. The first fan 100 is connected in-series to the second fan 102, as further described below. Thus, the first fan 100 provides cold air not only to the freezer compartment 24, but also provides cold air from the evaporator 80 to the second fan 102 as well. The second fan 102 provides cold air from the first fan 100 to the ice maker 30 via the duct assembly 70 during an ice making cycle. As such, the second fan 102 may be referred to herein as an ice maker fan. Thus, the first and second fans 100, 102 are operable between active and at-rest conditions, wherein the fans 100, 102 are running in the active condition and are not running in the at-rest condition. The condition of the first and second fans 100, 102 is controlled by a controller of the refrigerator 10, as further described below, which also controls the various cycles of the refrigerator 10.

**[0017]** As further shown in FIG. 3, the ice maker 30 includes first and second portions 30A, 30B. As illustrated, the ice maker feed duct 72 is interconnected between the evaporator housing 64, at the first portion 64A thereof, at the first end 74 of the ice maker feed duct 72, and the ice maker 30, at the first portion 30A thereof, at the second end 76 of the ice maker feed duct 72. As further illustrated in FIG. 3, the ice maker return duct 82 is interconnected between the ice maker 30, at the second portion 30B thereof, at the first end 84 of the ice maker return duct 82, and evaporator housing 64, at the second portion 64B thereof, at the second end 86 of the ice maker return duct 82. Thus, it is contemplated that the second fan 102 supplies cold air from the evaporator housing 64 to the ice maker 30 via the ice maker feed duct 72 of the duct assembly 70. The cold air powered by the second fan 102 is fed into the first portion 30A of the ice maker 30 by the ice maker feed duct 72. It is contemplated that ice is made in the first portion 30A of the ice maker 30. Cold air remaining from the ice making process is returned to the second portion 64B of the evaporator housing 64 by the ice maker return duct 82 4 recycling. In this way, the ice maker return duct 82 provides cold air to the evaporator housing 64 near the evaporator 80, such that the evaporator 80 can use the cold air leftover from an ice making process when providing cold air to the first fan 100. This results in an overall energy savings for the cold air producing process of the evaporator 80. Both the ice maker feed duct 72 and the ice maker return duct 82 are contemplated to be insulated ducts, as they are configured to carry much colder air as compared to cold air

provided to the refrigerator compartment 12 (FIGS. 1-2). The ice maker feed duct 72 and the ice maker return duct 82 are contemplated to be insulated by a gas impervious barrier having an insulating material, such that the super cooled air carried in the ice maker feed duct 72 and the ice maker return duct 82 is not diffused into other components of the refrigerator 10 along the travel path between the evaporator housing 64 and the ice maker 30.

**[0018]** Referring now to FIG. 4, the duct assembly 70 is shown disposed within the interior cavity 68 of the first sidewall 13A of the cabinet structure 13. As configured in FIG. 4, the ice maker feed duct 72 and the ice maker return duct 82 of the duct assembly 70 are entirely disposed within the interior cavity 68 of the first sidewall 13A of the cabinet structure 13. Thus, as noted above, the duct assembly 70 is disposed entirely within the first sidewall 13A of the cabinet structure 13 given the narrow profile of the duct assembly 70. The ice maker feed duct 72 is positioned vertically above the ice maker return duct 82, such that in the view of FIG. 4, the ice maker return duct 82 is largely concealed by the ice maker feed duct 72. This vertical overlapping configuration of the ice maker feed duct 72 and the ice maker return duct 82 helps to keep the profile of the overall duct assembly 70 narrow for reception within the interior cavity 68 of the first sidewall 13A of the cabinet structure 13.

**[0019]** Referring now to FIG. 5, the duct assembly 70 is shown with the ice maker feed duct 72 and the ice maker return duct 82 positioned with the respective body portions 78, 88 thereof in a substantially parallel relationship. As noted above, the ice maker feed duct 72 is positioned vertically above the ice maker return duct 82 in assembly. Also noted above, the respective body portions 78, 88 of the ice maker feed duct 72 and the ice maker return duct 82 are substantially linear to define direct has of airflow through the body portions 78, 88 as respectively indicated by arrows 78A, 88A. With specific reference to the ice maker feed duct 72, the body portion 78 thereof is an inclined body portion that upwardly ascends from the first end 74 to the second end 76 in a substantially linear manner. This inclined body portion 78 results in an inclined airflow, as indicated by arrow 78A, through the ice maker feed duct 72. With specific reference to the ice maker return duct 82, the body portion 88 thereof is an inclined body portion that downwardly ascends from the first end 84 to the second end 86 in a substantially linear manner. This inclined body portion 88 results in an inclined airflow, as indicated by arrow 88A, through the ice maker return duct 82. As used herein, the term "substantially linear" indicates that the body portions 78, 88 of the ice maker feed duct 72 and the ice maker return duct 82, respectively, are substantially straight or straight body portions that directly interconnect the evaporator housing 64 with the ice maker 30. As shown in FIG. 5, the first ends 74, 84 and the second ends 76, 86 include some curved portions that outwardly offset the body portions 78, 88, but the body portions 78, 88 themselves are substantially linear. As such, it is contemplated that the body portions 78, 88 of the ice maker feed duct 72 and the ice maker return duct 82, respectively, are 90% linear, 95% linear or more relative to the inclined portions of the body portions 78, 88 that are disposed within the interior cavity 68 of the first sidewall 13A of the cabinet structure 13, as shown in FIG. 3. Thus, the body portion 78 of the ice maker feed duct 72 defines a substantially linear ascending airway from the evaporator housing 64 to the ice maker 30. Similarly, the body portion 88 of the ice maker return duct 82 defines a substantially linear descending airway from the ice maker 30 to the evaporator housing 64. Thus, the inclined portion of the body portions 78, 88 of the ice maker feed duct 72 and ice maker return duct 82 are both linearly disposed within a single sidewall, the first sidewall 13A, of the cabinet structure 13.

**[0020]** The substantially linear ducts 72, 82 of the duct assembly 70 connects the source of cold air (the freezer evaporator 80) directly to the ice maker 30. This direct connection between the evaporator housing 64 and the ice maker 30 eliminates the need for door ducts which would introduce branching to the substantially linear duct design. In this way, the total length of the airways defined by the ice maker feed duct 72 and the ice maker return duct 82 going from the evaporator 80 to the ice maker 30 is greatly reduced. Also, the air resistance to reach the ice maker 30 is greatly reduced because cold air traveling along the airflow path indicated by arrow 78A does not have to turn in a torturous path from cabinet ducts to door ducts. As a result, the pressure drop across the ducts 72, 82 is reduced by more than 50% at the same airflow cfm rate. Due to lesser pressure drop across the ducts 72, 82, the pressure in the freezer compartment 24 increases from -0.04" of water to less than -0.02" of water. Thus, the infiltration inside freezer compartment 24 from the ambient air surrounding the same is greatly reduced due to reduction in negative pressure in the freezer compartment 24. With the current linear duct assembly 70, test results show no frost formation in the freezer compartment 24 at standard fan speeds. Frost formation is measured on the Leichert's Scale ranging from 0, which indicates a completely clean or frost free environment, to 7, which is indicates a frost accumulation of more than a four square inch area. Based on simulations conducted with standard ducts having indirect non-linear pathways, an equation was created to predict the frost formation based on the Leichert's Scale. The results of the equation show the Leichert's Scale scale moving from a range of about 4-7 on the Leichert's Scale in the non-linear duct assemblies, to about 0-2 on the Leichert's Scale with the substantially linear ducts 72, 82 of the present concept.

**[0021]** Referring now to FIG. 6, the first fan 100 includes first and second sides 100A, 100B which respectively indicate intake and output sides of the first fan 100. Similarly, the second fan 102 includes first and second sides 102A, 102B which respectively indicate intake and output sides of the second fan 102. As noted above, the

first and second fans 100, 102 are arranged in-series with the second side 100B of the first fan 100 being fluidically coupled to the first side 102A of the second fan 102 by an inlet 110. Specifically, the first side 100A of the first fan 100 opens into a spacing 103 that fluidically interconnects the first fan 100 and the evaporator 80 to provide cold air from the evaporator 80 to the first side 100A of the first fan 100. It is contemplated that the spacing 103 may be a direct duct member that interconnects the first fan 100 with the evaporator 80. It is also contemplated that the spacing 103 may be defined by the evaporator housing cover 65 (FIG. 2), such that the spacing 103 is an open spacing between the first side 100A of the first fan 100 and the evaporator 80. The second side 100B of the first fan 100 opens into an outlet 104 for providing cooled air to the freezer compartment 24. Specifically, the outlet 104 includes first and second ends 105A, 105B and a body portion 105 disposed between the first and second ends 105A, 105B. The first end 105A of the outlet 104 is fluidically coupled to the second side 100B of the first fan 100. The second end 105B of the outlet 104 opens into the freezer compartment 24 to fluidically interconnect the first fan 100 with the freezer compartment 24. As further shown in FIG. 6, the inlet 110 includes first and second ends 112A, 112B have a body portion 112 disposed therebetween. The first end 112A of the inlet 110 is fluidically coupled to the body portion 105 of the outlet 104. The second end 112B of the inlet 110 is fluidically coupled with the second fan 102 at the first side 102A of the second fan 102. As further shown in FIG. 6, the second side 102B of the second fan 102 is fluidically coupled to the first end 74 of the ice maker feed duct 72. Thus, the first and second fans 100, 102 are configured in-series wherein the first fan 100 is the only fan directly connected to the evaporator 80 through the spacing 103, and the second fan 102 is fluidically interconnected with the evaporator 80 only through the inlet 110 and outlet 104 with the first fan 100 disposed therebetween. Thus, the first fan 100 is the only fan that can draw cooled air from the evaporator 80 directly, as the second fan 102 is only coupled to the evaporator 80 through the first fan 100.

**[0022]** As used herein, the terms "fluidically coupled", "fluidically connected" or "fluidically interconnected" indicates that two or more structures are connected to one another in such a way as to provide for fluid airflow between the two or more structures. Said differently, an airway interconnects the two or more structures, such as the duct assembly 70 fluidically interconnecting the ice maker 30 and the evaporator housing 64. Also as used herein, the term "in-series" indicates two or more structures that are serially aligned along an airway, such as the first and second fans 100, 102.

**[0023]** Referring now to FIG. 7, it is contemplated that a controller 120 for the refrigerator 10 is provided that controls both the first fan 100 and the second fan 102, such that they can run oscillate between the active and at-rest conditions during distinct cooling cycles (i.e. a freezer compartment cooling cycle, and an ice making cycle). The controller 120 is shown in FIG. 7 as being operably coupled to the first and second fans 100, 102 and the evaporator 80, for controlling the same. Specifically, the first and second fans 100, 102 are controlled by the controller 120 between the active and at-rest conditions, while the evaporator 80 can be controlled by the controller 120 to provide various temperature levels of cold air as needed per a specific refrigerator cycle. It is consummated that the controller 120 can be positioned at any portion within the refrigerator 10, so long as the controller 120 is electronically coupled with the first and second fans 100, 102 and the evaporator 80. It is contemplated that the first fan 100 will be in the active condition and will run during a freezer compartment cooling cycle with cold air temperatures provided to the freezer compartment 24 at a first temperature level via the evaporator 80. It is contemplated that the second fan 102 will be in the at-rest condition and not run during the freezer compartment cooling cycle, so as not to unnecessarily draw air intended for the freezer compartment 24 to the ice maker 30. However, as noted above, the second fan 102 is fluidically coupled to the first fan 100 which is fluidically coupled to the evaporator 80. Thus, even when the second fan 102 is in the at-rest condition, cold air from the evaporator 80 will be propelled by the first fan 100 to not only the freezer compartment 24 via outlet 104, but cold air from the evaporator 80 will also be propelled by the first fan 100 to the inlet 110. As noted above, the inlet 110 is fluidically coupled to the second fan 102 which is fluidically coupled to the duct assembly 70 which is fluidically coupled to the ice maker 30. In this way, cold air from the evaporator 80 is provided to the ice maker 30 by the first fan 100 when the first fan 100 is in the active condition during a freezer compartment cooling cycle, even though the second fan 102 is in the at-rest condition. The cold air from the evaporator 80 is provided to the ice maker 30 by the first fan 100 during a freezer compartment cooling cycle a level sufficient to keep already formed and stored ice in the ice maker 30 from melting.

**[0024]** Further, it is contemplated that the second fan 102 will be in the active condition and will run during an ice making cycle with temperatures provided at a second temperature level via the evaporator 80. It is contemplated that the second temperature level of cold air provided by the evaporator 80 is less than the first temperature level. The second temperature level is contemplated to be a temperature level below freezing to provide appropriate temperatures of cooled air for making ice in the ice maker 30. It is contemplated that the first fan 100 will also be in the active condition and will run during the ice making cycle along with the second fan 102. As the first fan 100 and the second fan 102 are connected in-series, the first fan 100 will assist the second fan 102 in providing cooled air to the ice maker 30, rather than having the first fan 100 compete with the second fan 102 for cooled air from the evaporator 80.

**[0025]** With further reference to FIG. 7, the first fan 100 is configured for rotation along the path as indicated by arrow R1 when the first fan 100 is in the active condition. Similarly, the second fan 102 is configured for rotation along the path as indicated by arrow R2 when the second fan 102 is in the active condition. As noted above, the first and second fans 100, 102 are arranged in-series with the second side 100B of the first fan 100 being fluidically coupled to the first side 102A of the second fan 102 by the inlet 110, as shown in FIG. 6. In the schematic view of FIG. 7, the first fan 100 opens into the spacing 103 that fluidically interconnects the first fan 100 with the evaporator 80 to provide cold air from the evaporator 80 to the first fan 100. The first fan 100 directs cold air from the evaporator 80 into the outlet 104 for providing cooled air to the freezer compartment 24 via venting apertures 106 that are contemplated to open into the freezer compartment 24 to fluidically interconnect the first fan 100 with the freezer compartment 24. The body portion 105 of the outlet 104 is further coupled, in a fluidic manner, to the first end 112A of the inlet 110. As noted above, and shown schematically in FIG. 7, the second end 112B of the inlet 110 is fluidically coupled with the second fan 102. While only the first fan 100 is fluidically coupled to the evaporator 80 in a direct manner, cold air from the evaporator 80 is provided to the ice maker 30 during a freezer compartment cooling cycle of the refrigerator 10. Relative airflow to the freezer compartment 24 is indicated in FIG. 7 by the four arrows emanating from the first fan 100 towards the venting apertures 106 within the outlet 104. Further, relative airflow to the inlet 110 is indicated in FIG. 7 by the arrow emanating from the first fan 100 towards the inlet 110. Thus, a majority of the cold air from the evaporator 80 is provided to the freezer compartment 24 during a freezer compartment cooling cycle of the refrigerator 10 as powered by the first fan 100 alone. A smaller portion of cold air is provided to the ice maker 30 through the inlet 110 in the duct assembly 70 during the freezer compartment cooling cycle as powered by the first fan 100 in the active condition, even when the second fan 102 is in the at-rest condition. As noted above, this portion of cold air provided by the first fan 100 to the ice maker 30 during a freezer compartment cooling cycle is enough to keep ice stored in the ice maker 30 from melting.

**[0026]** Referring now to FIG. 8, the ice maker 30 is shown with the first end 74 of the ice maker feed duct 72 shown feeding cold air into the first portion 30A of the ice maker 30 along an airflow path as indicated by arrow AF1. The cold air provided to the first portion 30A of the ice maker 30 via the ice maker feed duct 72 is used to create ice within the ice maker 30. Cold air then travels from the first portion 30A of the ice maker 30 to the second portion 30B of the ice maker 30 along the airflow path indicated by arrow AF2. Cold air then exits the second portion 30B of the ice maker 30 along the airflow path indicated by arrow AF3 to return to the evaporator housing 64 for recycling via the ice maker return duct 82.

**[0027]** Referring now to FIG. 9, the evaporator housing 64 is shown with the evaporator plate 81 surrounding the evaporator 80 which opens into the spacing 103 disposed adjacent to the first side 100A of the first fan 100. In this way, the spacing 103 defines an airway from the evaporator 80 for cold air to fluidically connect with the first side 100A of the first fan 100 for intake and distribution into the freezer compartment 24, as powered by the first fan 100, and distribution into the ice maker 30, as powered by the first fan 100 alone or in combination with the second fan 102 in a manner as described above. As shown in FIG. 9, the second fan 102 includes a housing 122 that further includes a mounting flange 124. The housing 122 surrounds and insulates the second fan 102 from the spacing 103, such that the second fan 102 is not in direct fluid communication with the spacing 103 and the cold air from the evaporator 80. The mounting flange 124 of the housing 122 is configured to couple to the rear wall 40 (FIG. 1) of the exterior wrapper 32, or the evaporator housing cover 65 (FIG. 2).

**[0028]** According to one aspect of the present disclosure, a refrigerator includes a cabinet structure having a refrigerator compartment and a freezer compartment. An evaporator is positioned in the freezer compartment within an evaporator housing. A door is pivotally coupled to the cabinet structure for selectively providing access to the refrigerator compartment. The door includes an ice maker operably coupled to the door for pivoting movement therewith. A duct assembly includes an ice maker feed duct that is operably coupled to the evaporator housing at a first end and further coupled to the ice maker at a second end. The duct assembly further includes an ice maker return duct operably coupled to the ice maker at a first end and further coupled to the evaporator housing at a second end.

**[0029]** According to another aspect of the present disclosure, the ice maker feed duct includes a body portion disposed between the first and second ends of the ice maker feed duct, and further wherein the body portion of the ice maker feed duct defines a substantially linear ascending airway.

**[0030]** According to another aspect of the present disclosure, the ice maker return duct includes a body portion disposed between the first and second ends of the ice maker return duct, and further wherein the body portion of the ice maker return duct defines a substantially linear ascending airway.

**[0031]** According to another aspect of the present disclosure, a first fan fluidically coupled to the evaporator housing for providing cold air from the evaporator to the first fan.

**[0032]** According to another aspect of the present disclosure, an outlet having a first end fluidically coupled to the first fan and a second end opening into the freezer compartment to interconnect the first fan with the freezer compartment, wherein the outlet includes a body portion disposed between the first and second ends of the outlet and an inlet having first and second ends, wherein the

inlet is fluidically coupled to the body portion of the outlet at the first end of the inlet.

**[0033]** According to another aspect of the present disclosure, a second fan fluidically coupled between the second end of the inlet, wherein the second fan is further fluidically coupled to the first end of the ice maker feed duct.

**[0034]** According to another aspect of the present disclosure, the second fan is fluidically interconnected to the evaporator only through the inlet and outlet with the first fan disposed therebetween.

**[0035]** According to another aspect of the present disclosure, the ice maker feed duct includes a body portion between the first and second ends of the ice maker feed duct, and further wherein an inclined portion of the body portion of the ice maker feed duct is linearly disposed within a single sidewall of the cabinet structure.

**[0036]** According to another aspect of the present disclosure, the ice maker return duct includes a body portion disposed between the first and second ends of the ice maker return duct, and further wherein an inclined portion of the body portion of the ice maker return duct is linearly disposed within a single sidewall of the cabinet structure.

**[0037]** According to another aspect of the present disclosure, the ice maker feed duct and the ice maker return duct are insulated ducts.

**[0038]** According to another aspect of the present disclosure, a refrigerator includes a cabinet structure having a refrigerator compartment, a freezer compartment and at least one sidewall with an interior cavity. An evaporator housing is positioned within the freezer compartment and includes first and second portions. An evaporator is positioned within the first portion of an evaporator housing. A duct assembly includes an ice maker feed duct operably coupled to the second portion of the evaporator housing at a first end and further coupled to an ice maker disposed above the freezer compartment at a second end. The duct assembly further includes an ice maker return duct operably coupled to the ice maker at a first end and further coupled to the first portion of the evaporator housing at a second end. The ice maker feed duct and the ice maker return duct include substantially linear body portions disposed within the interior cavity of the at least one sidewall of the cabinet structure.

**[0039]** According to another aspect of the present disclosure, a freezer compartment fan disposed in the second portion of the evaporator housing and fluidically coupled to the first portion of the evaporator housing.

**[0040]** According to another aspect of the present disclosure, an ice maker fan disposed in the second portion of the evaporator housing and fluidically coupled to the first end of the ice maker feed duct.

**[0041]** According to another aspect of the present disclosure, the ice maker fan is fluidically coupled to the freezer compartment fan in-series.

**[0042]** According to yet another aspect of the present disclosure, a refrigerator includes first and second fans each having a first side and a second side. The first and second fans are arranged in-series with the second side of the first fan fluidically coupled to the first side of the second fan by an inlet. An evaporator is disposed within a freezer compartment and fluidically coupled to the first side of the first fan. An ice maker is disposed outside of the freezer compartment and fluidically coupled to the second side of the second fan by an ice maker feed duct. An ice maker return duct is fluidically coupled between the ice maker and the evaporator.

**[0043]** According to another aspect of the present disclosure, a controller for controlling the evaporator between a freezer compartment cooling cycle and an ice making cycle, wherein the controller further controls the first and second fans between active and at-rest conditions.

**[0044]** According to another aspect of the present disclosure, the first fan is in the active condition and the second fan is in the at-rest condition during the freezer compartment cooling cycle.

**[0045]** According to another aspect of the present disclosure, cold air from the evaporator is provided at a first temperature level to the ice maker during the freezer compartment cooling cycle.

**[0046]** According to another aspect of the present disclosure, the first fan is in the active condition and the second fan is in the active condition during the ice making cycle.

**[0047]** According to another aspect of the present disclosure, cold air from the evaporator is provided at a second temperature level to the ice maker during the ice making cycle, and further wherein the second temperature level is lower than the first temperature level.

**[0048]** According to another aspect of the present disclosure, a refrigerator includes a cabinet structure having a refrigerator compartment and a freezer compartment. An evaporator is positioned in the freezer compartment within an evaporator housing. The refrigerator includes an ice maker. A duct assembly includes an ice maker feed duct that is operably coupled to the evaporator housing at a first end and further coupled to the ice maker at a second end. The duct assembly further includes an ice maker return duct operably coupled to the ice maker at a first end and further coupled to the evaporator housing at a second end.

**[0049]** According to another aspect of the present disclosure, the ice maker feed duct includes a body portion disposed between the first and second ends of the ice maker feed duct, and further wherein the body portion of the ice maker feed duct defines a substantially linear ascending airway.

**[0050]** According to another aspect of the present disclosure, the ice maker return duct includes a body portion disposed between the first and second ends of the ice maker return duct, and the body portion of the ice maker return duct defines a substantially linear descending airway.

**[0051]** According to another aspect of the present disclosure, a first fan is fluidically coupled to the evaporator

housing for providing cold air from the evaporator to the first fan.

**[0052]** According to another aspect of the present disclosure, an outlet includes a first end fluidically coupled to the first fan and a second end opening into the freezer compartment to interconnect the first fan with the freezer compartment. The outlet includes a body portion disposed between the first and second ends of the outlet. An inlet includes first and second ends and is fluidically coupled to the body portion of the outlet at the first end of the inlet.

**[0053]** According to another aspect of the present disclosure, a second fan is fluidically coupled between the second end of the inlet, and is further fluidically coupled to the first end of the ice maker feed duct.

**[0054]** According to another aspect of the present disclosure, the second fan is fluidically interconnected to the evaporator only through the inlet and outlet with the first fan disposed therebetween.

**[0055]** According to another aspect of the present disclosure, the ice maker feed duct includes a body portion between the first and second ends of the ice maker feed duct, and an inclined portion of the body portion of the ice maker feed duct is linearly disposed within a single sidewall of the cabinet structure.

**[0056]** According to another aspect of the present disclosure, the ice maker return duct includes a body portion disposed between the first and second ends of the ice maker return duct, and an inclined portion of the body portion of the ice maker return duct is linearly disposed within a single sidewall of the cabinet structure.

**[0057]** According to another aspect of the present disclosure, the ice maker feed duct and the ice maker return duct are insulated ducts.

**[0058]** According to another aspect of the present disclosure, the duct assembly is disposed within an interior cavity of a sidewall of the cabinet structure.

**[0059]** According to another aspect of the present disclosure, a controller controls the evaporator between a freezer compartment cooling cycle and an ice making cycle. The controller further controls the first and second fans separately between active and at-rest conditions.

**[0060]** According to another aspect of the present disclosure, the first fan is in the active condition and the second fan is in the at-rest condition during the freezer compartment cooling cycle. Cold air from the evaporator is provided at a first temperature level to the ice maker during the freezer compartment cooling cycle.

**[0061]** According to another aspect of the present disclosure, the first fan is in the active condition and the second fan is in the active condition during the ice making cycle. Cold air from the evaporator is provided at a second temperature level that is lower than the first temperature level to the ice maker during the ice making cycle.

**[0062]** According to another aspect of the present disclosure, a door is pivotally coupled to the cabinet structure for selectively providing access to the refrigerator compartment. The ice maker is operably coupled to the door for pivoting movement therewith.

## Claims

**1.** A refrigerator (10), comprising:

a cabinet structure (13) having a refrigerator compartment (12) and a freezer compartment (24);
an evaporator (80) positioned in the freezer compartment (24) within an evaporator housing (64);
an ice maker (30); and
a duct assembly (70) having an ice maker feed duct (72) operably coupled to the evaporator housing (64) at a first end (74) and further coupled to the ice maker (30) at a second end (76), wherein the duct assembly (70) further includes an ice maker return duct (82) operably coupled to the ice maker (30) at a first end (84) and further coupled to the evaporator housing (64) at a second end (86),
wherein the ice maker feed duct (72) includes a body portion (78) disposed between the first and second ends (74, 76) of the ice maker feed duct (72), said body portion (78) defining a substantially linear ascending airway,
and wherein the ice maker return duct (82) includes a body portion (88) disposed between the first and second ends (84, 86) of the ice maker return duct (82), said body portion (88) defining a substantially linear descending airway.

**2.** The refrigerator (10) of claim 1, including:
a first fan (100) fluidically coupled to the evaporator (80) for providing cold air from the evaporator (80).

**3.** The refrigerator (10) of claim 2, including:

an outlet (104) having a first end (105A) fluidically coupled to the first fan (100) and a second end (105B) opening into the freezer compartment (24) to interconnect the first fan (100) with the freezer compartment (24), wherein the outlet (104) includes a body portion (105) disposed between the first and second ends (105A, 105B) of the outlet (104); and
an inlet (110) having first and second ends (112A, 112B), wherein the inlet (110) is fluidically coupled to the body portion (105) of the outlet (104) at the first end (112A) of the inlet (110).

**4.** The refrigerator (10) of claim 3, including:
a second fan (102) fluidically coupled to the second end (112B) of the inlet (110), wherein the second fan (102) is further fluidically coupled to the first end (74) of the ice maker feed duct (72).

5. The refrigerator (10) of claim 4, wherein the second fan (102) is fluidically interconnected to the evaporator (80) only through the inlet (110) and the outlet (104) with the first fan (100) disposed therebetween.

6. The refrigerator (10) of claim 1, wherein the ice maker feed duct (72) includes a body portion (78) disposed between the first and second ends (74, 76) of the ice maker feed duct (72), and further wherein an inclined portion (78) of the body portion (78) of the ice maker feed duct (72) is linearly disposed within a single sidewall (13A) of the cabinet structure (13).

7. The refrigerator (10) of any one of claim 1, wherein the ice maker return duct (82) includes a body portion (88) disposed between the first and second ends (84, 86) of the ice maker return duct (82), and further wherein an inclined portion (88) of the body portion (88) of the ice maker return duct (82) is linearly disposed within a single sidewall (13A) of the cabinet structure (13).

8. The refrigerator (10) of any one of claims 1-7, wherein the ice maker feed duct (72) and the ice maker return duct (82) are insulated ducts.

9. The refrigerator (10) of claim 1, wherein the duct assembly (70) is disposed within an interior cavity (68) of a sidewall (13A) of the cabinet structure (13).

10. The refrigerator (10) of claim 4, further including:
a controller (120) for controlling the evaporator (80) between a freezer compartment cooling cycle and an ice making cycle, wherein the controller (120) further controls the first and second fans (100, 102) separately between active and at-rest conditions.

11. The refrigerator (10) of claim 10, wherein the first fan (100) is in the active condition and the second fan (102) is in the at-rest condition during the freezer compartment cooling cycle, and further wherein cold air from the evaporator (80) is provided at a first temperature level to the ice maker (30) during the freezer compartment cooling cycle.

12. The refrigerator (10) of claim 10 or 11, wherein the first fan (100) is in the active condition and the second fan (102) is in the active condition during the ice making cycle, and further wherein cold air from the evaporator (80) is provided at a second temperature level that is lower than the first temperature level to the ice maker (30) during the ice making cycle.

13. The refrigerator (10) of any one of claims 1-12, including:
a door (18) pivotally coupled to the cabinet structure (13) for selectively providing access to the refrigerator compartment (12), wherein the ice maker (30) is operably coupled to the door (18) for pivoting movement therewith.

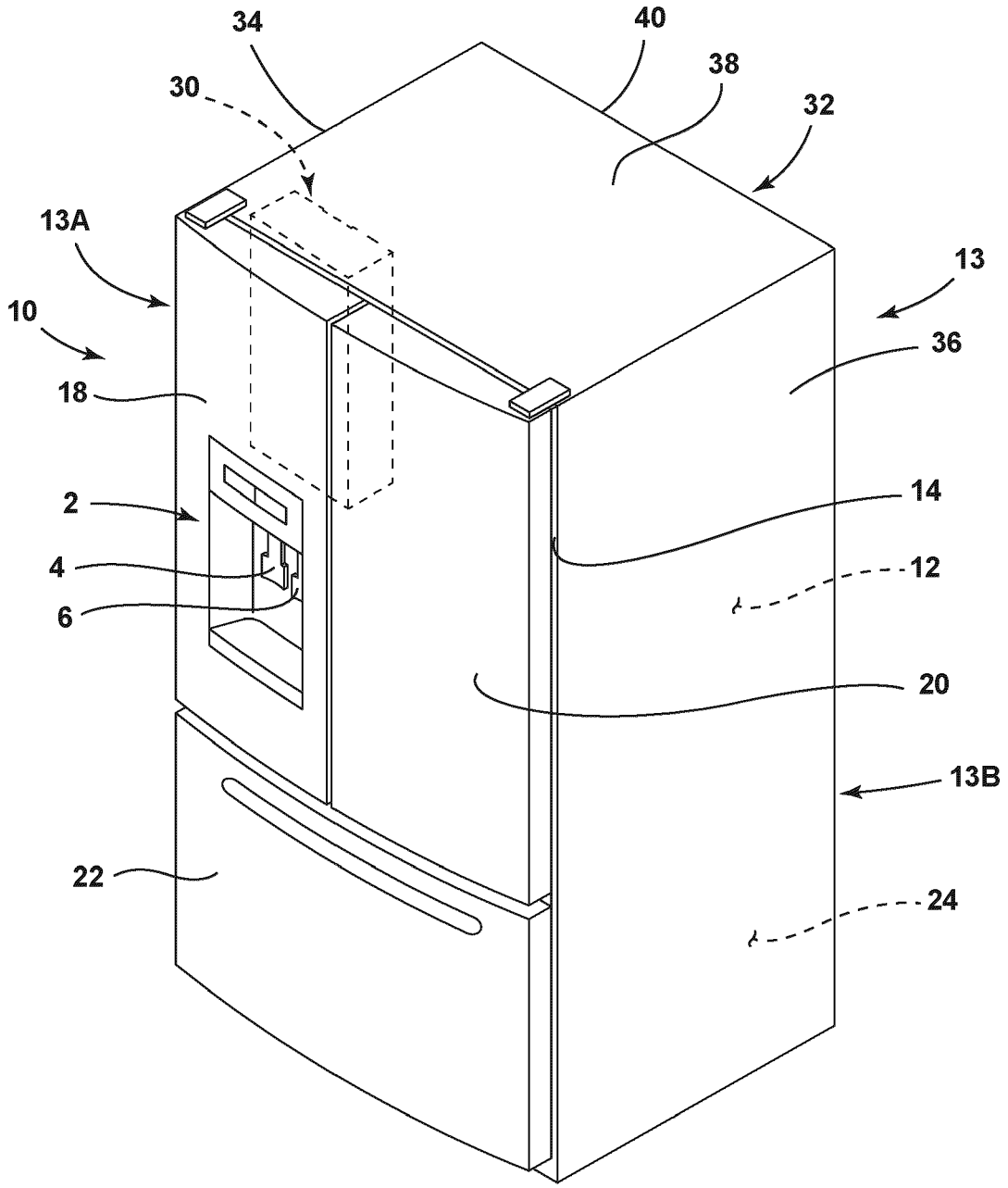
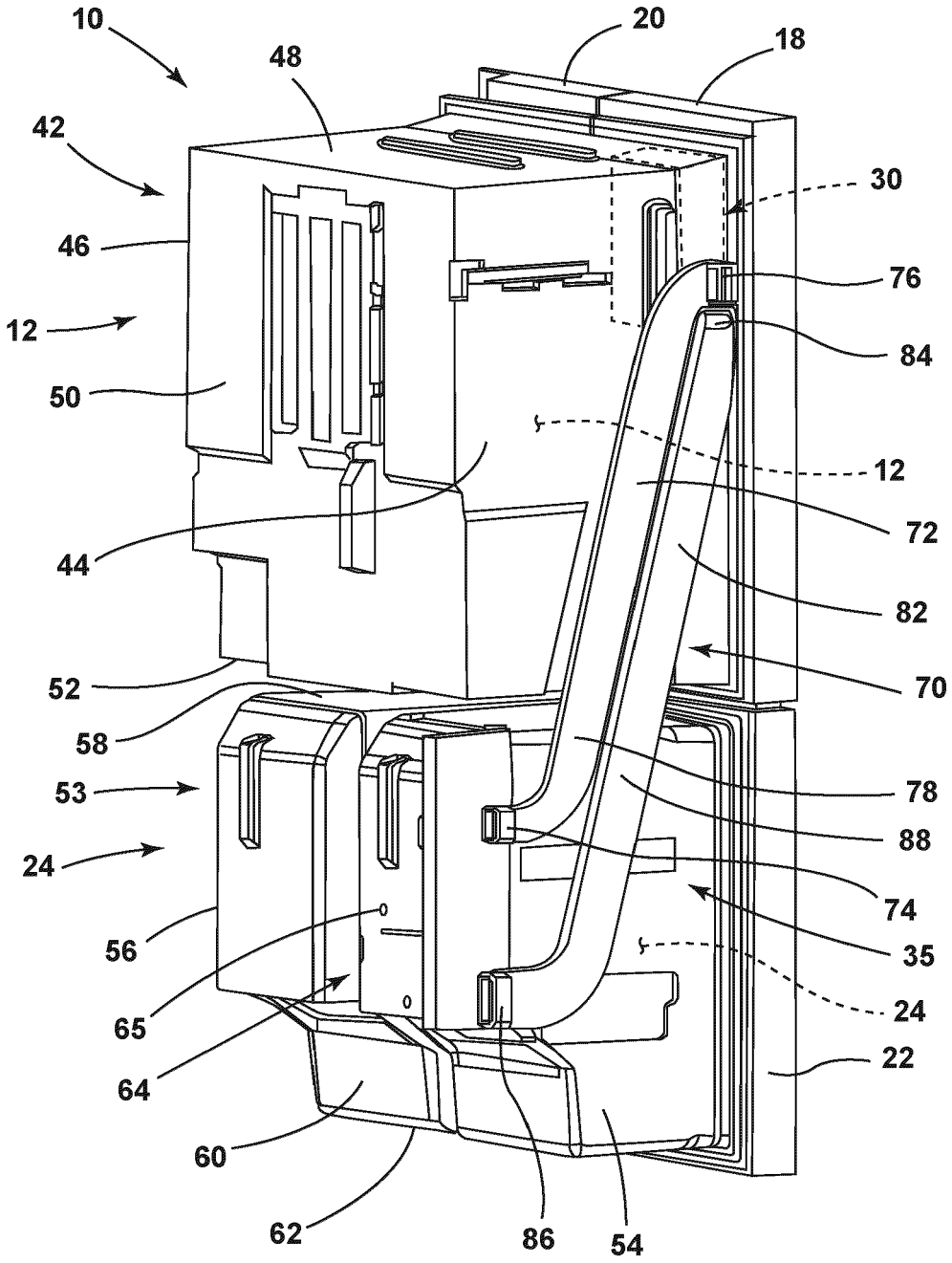



FIG. 1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18
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12
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72
44
82
70
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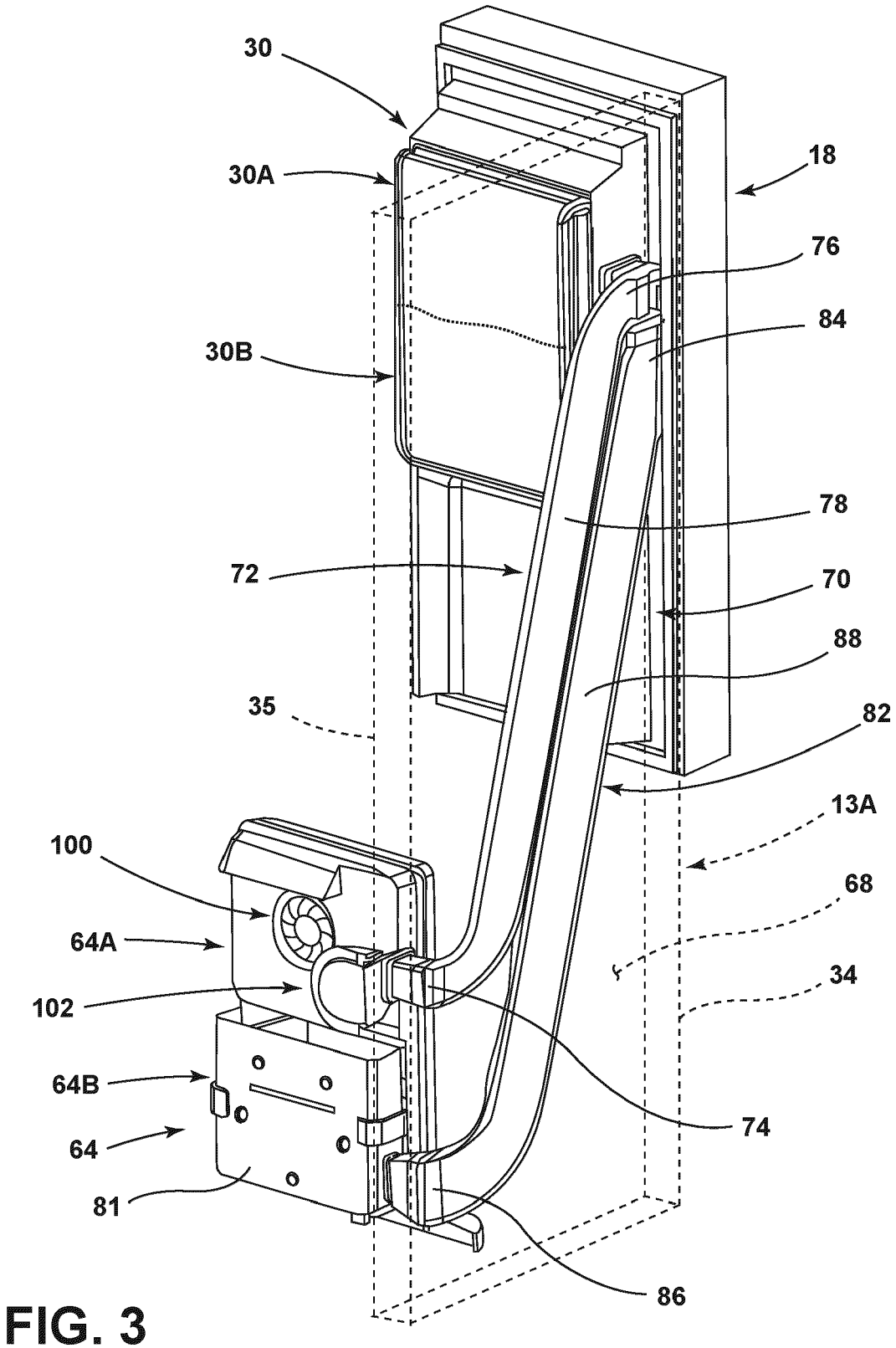
88
24
74
35
56
24
65
22
64
60
62
86
54

FIG. 2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30A
18
76
84
30B
78
72
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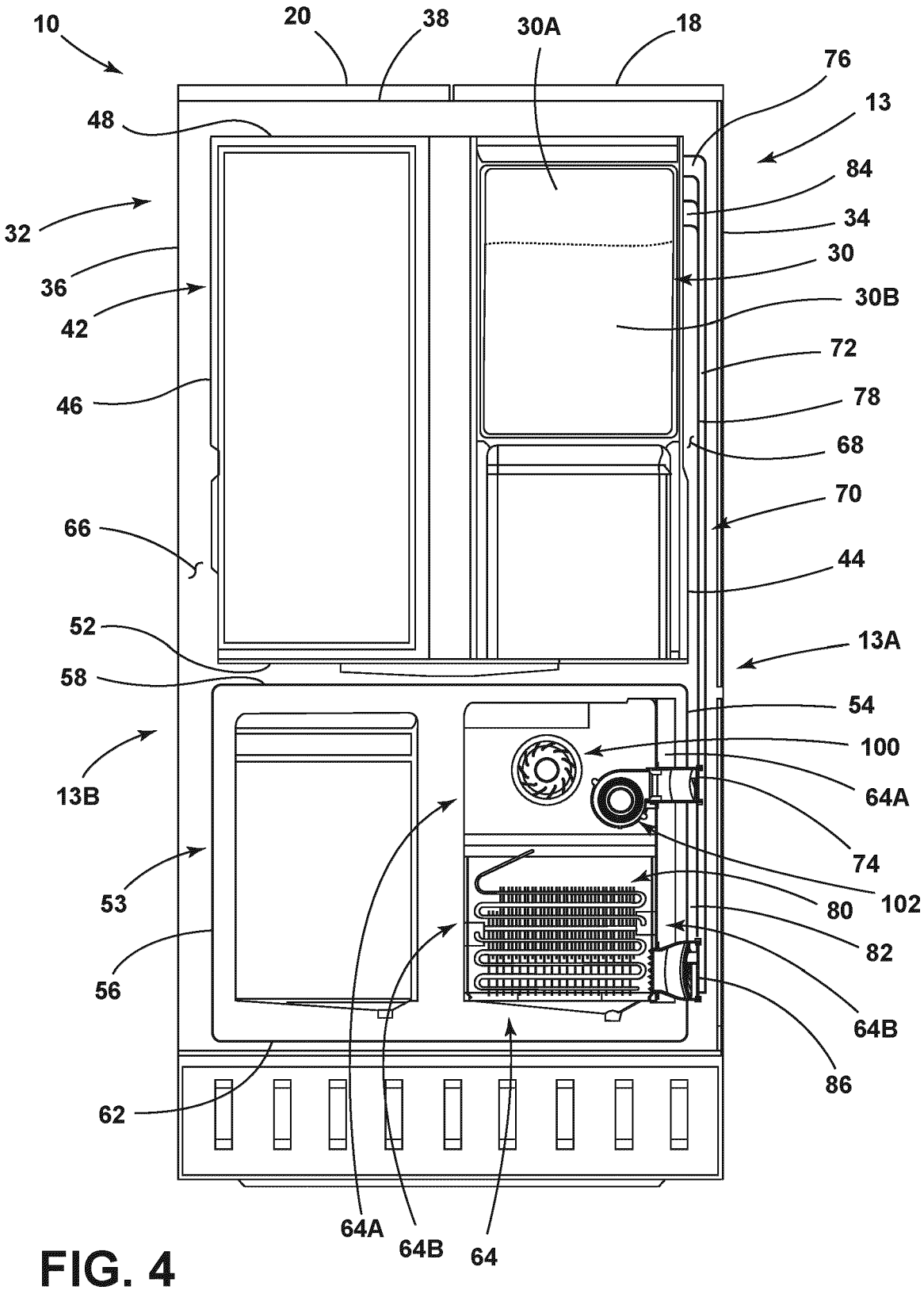
88
35
82
13A
100
68
64A
34
102
74
64B
64
81
86

FIG. 3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30A
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76
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84
32
34
30
36
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42
72
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78
68
70
66
44
52
13A
58
54
100
13B
64A
74
53
102
80
82
56
64B
86
62
64A
64B
64

FIG. 4

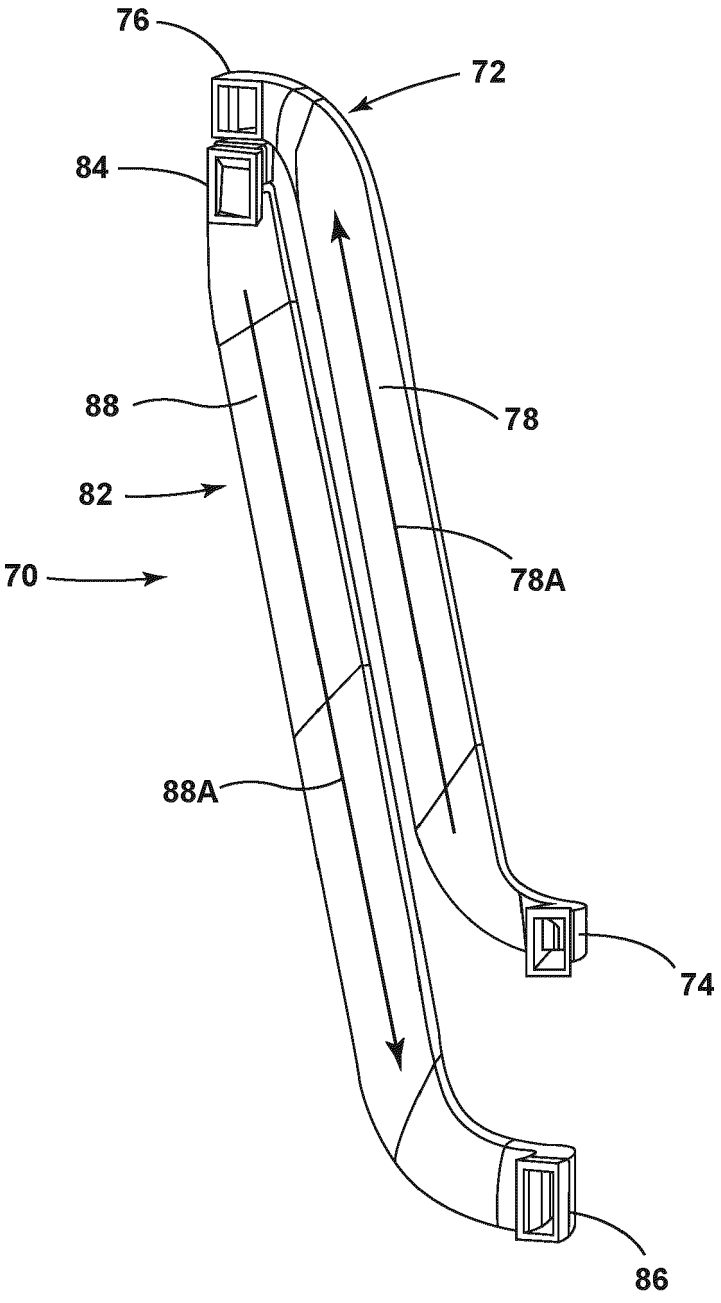


FIG. 5

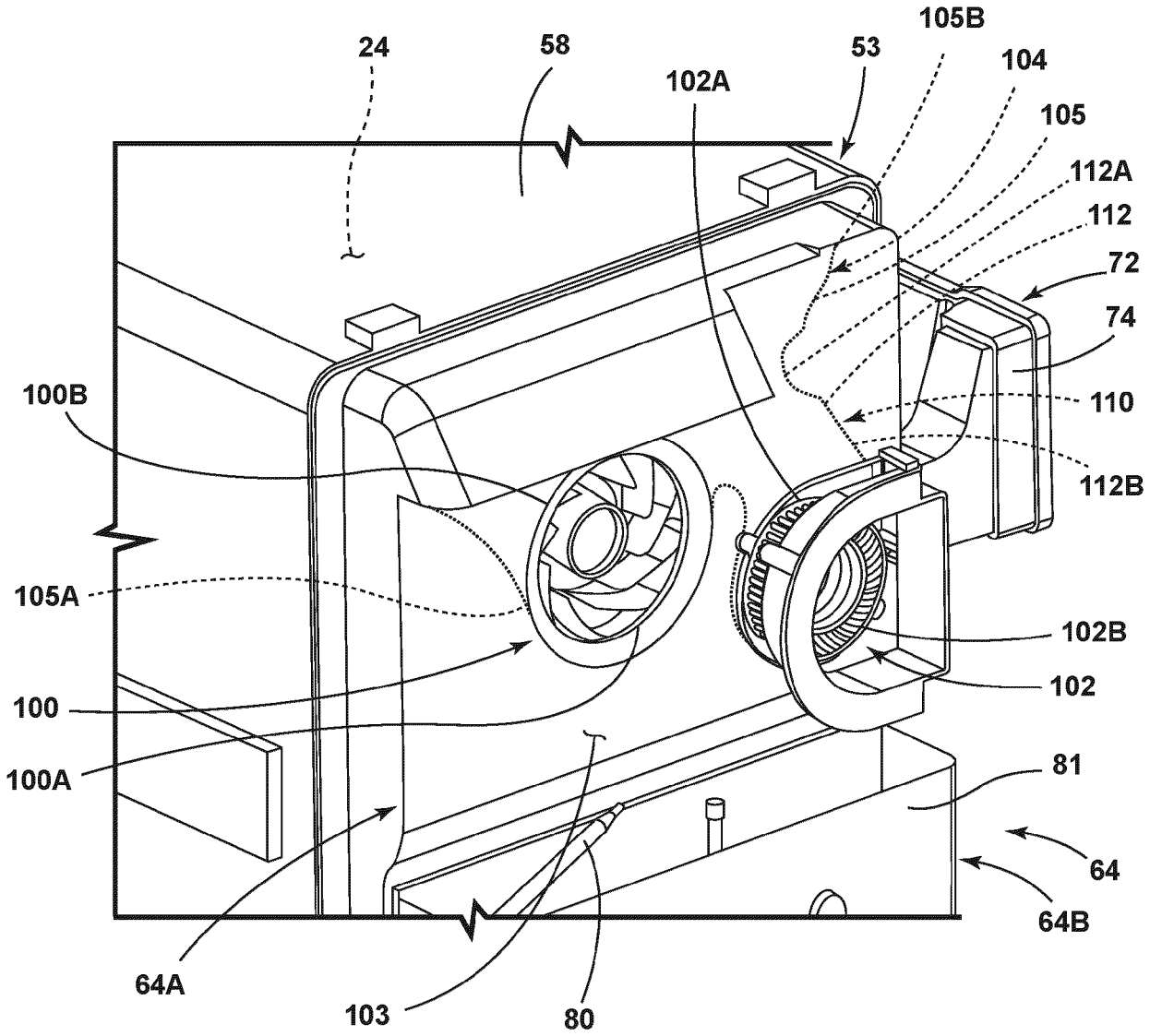
24
58
102A
53
105B
104
105
112A
112
72
74
110
112B
100B
105A
102B
102
100
100A
81
64
64B
64A
103
80

FIG. 6

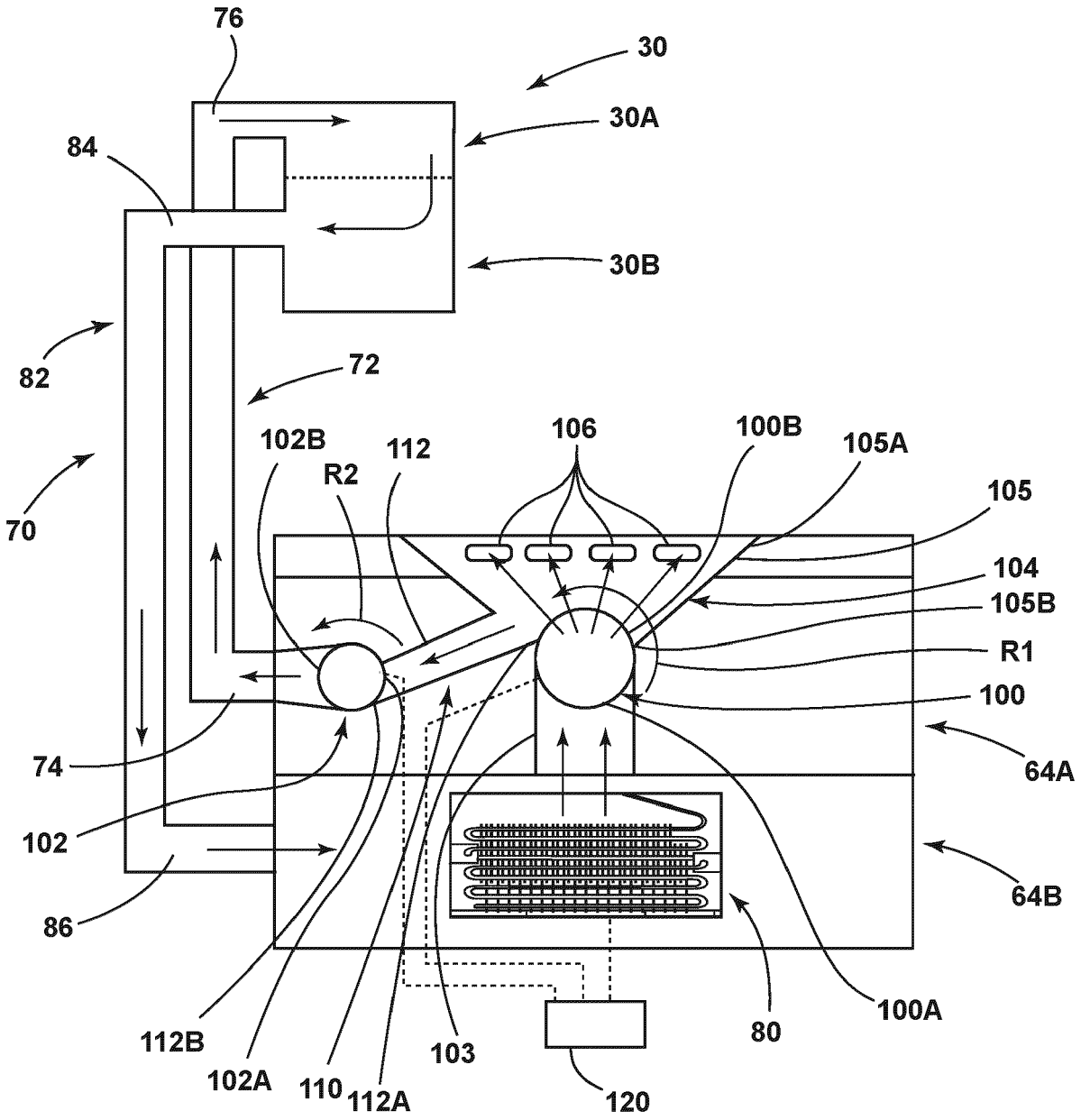
76
30
30A
84
30B
82
72
70
102B
112
R2
106
100B
105A
105
104
105B
R1
100
74
64A
102
64B
86
112B
102A
110
112A
103
120
80
100A

FIG. 7

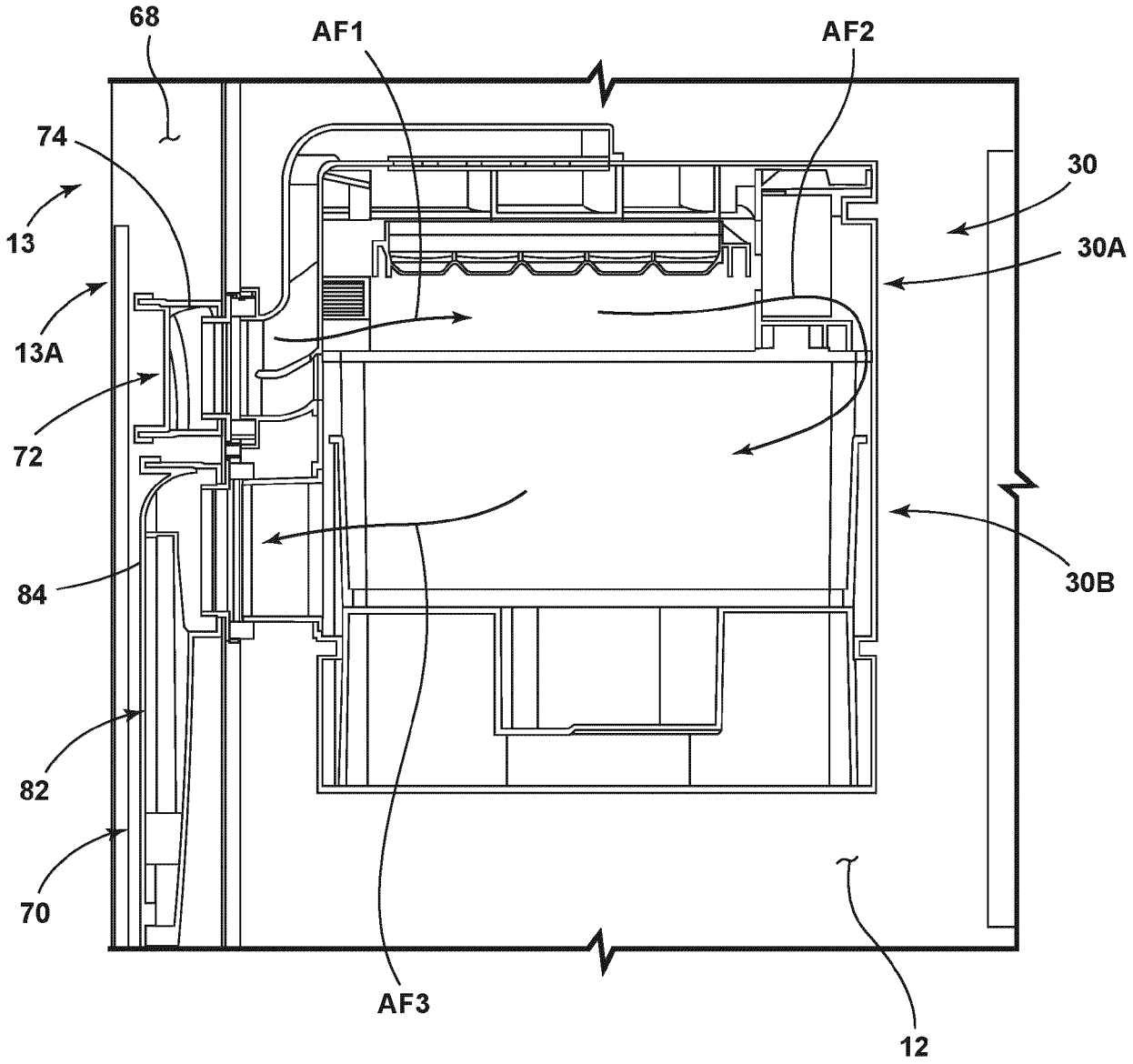


FIG. 8

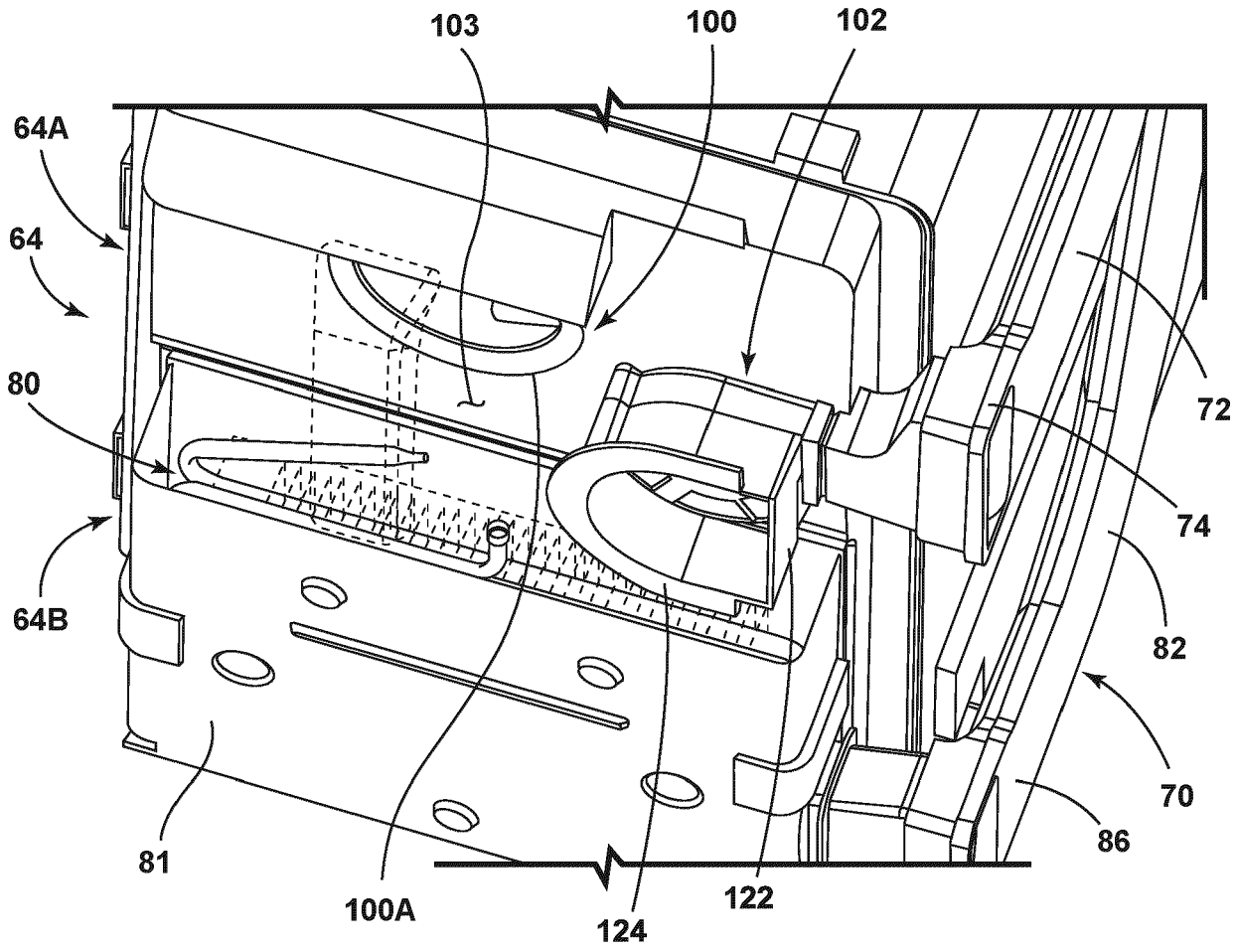


FIG. 9

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# EUROPEAN SEARCH REPORT

Application Number
EP 21 15 4881

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| X | CN 102 818 414 A (HAIER GROUP CO LTD; QINGDAO HAIER CO LTD) 12 December 2012 (2012-12-12) | 1-9,13 | INV. F25D17/06 F25D23/06 |
| Y | * abstract; figures 1-2 * | 10-12 | |
| X | US 2018/164020 A1 (GARY ADAM [US] ET AL) 14 June 2018 (2018-06-14) | 1-9 | ADD. F25D23/04 |
| Y | * Abstract, figures 1-4 and paragraphs [0015]-[0025] * | 10-12 | |
| X,P | EP 3 683 528 A1 (WHIRLPOOL CO [US]) 22 July 2020 (2020-07-22) * abstract; figures 1-8 * | 1-9 | |
| X | US 2019/360737 A1 (LV ZHENGGUANG [CN] ET AL) 28 November 2019 (2019-11-28) * the whole document * | 1 | |
| X | CN 205 860 622 U (HEFEI HUALING CO LTD; MIDEA GROUP CO LTD) 4 January 2017 (2017-01-04) * the whole document * | 1 | |
| X | KR 2018 0049670 A (LG ELECTRONICS INC [KR]) 11 May 2018 (2018-05-11) * the whole document * | 1 | |
| X | WO 2019/101000 A1 (HEFEI HUALING CO LTD [CN]; HEFEI MIDEA REFRIGERATOR CO [CN] ET AL.) 31 May 2019 (2019-05-31) * the whole document * | 1 | |
| X | US 2006/179869 A1 (LEE MYUNG R [KR] ET AL) 17 August 2006 (2006-08-17) * abstract; figures 1-9 * | 1 | |

TECHNICAL FIELDS SEARCHED (IPC)
F25D
F25B
F25C

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 8 July 2021 | Bejaoui, Amin |

CATEGORY OF CITED DOCUMENTS

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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 21 15 4881

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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08-07-2021

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| CN 102818414 A | 12-12-2012 | NONE | |
| US 2018164020 A1 | 14-06-2018 | EP 3336461 A1 | 20-06-2018 |
| | | US 2018164020 A1 | 14-06-2018 |
| EP 3683528 A1 | 22-07-2020 | CN 111442593 A | 24-07-2020 |
| | | EP 3683528 A1 | 22-07-2020 |
| | | US 2020224957 A1 | 16-07-2020 |
| US 2019360737 A1 | 28-11-2019 | AU 2017398148 A1 | 29-08-2019 |
| | | CA 3053253 A1 | 16-08-2018 |
| | | CN 106907889 A | 30-06-2017 |
| | | US 2019360737 A1 | 28-11-2019 |
| | | WO 2018145354 A1 | 16-08-2018 |
| | | ZA 201905552 B | 27-01-2021 |
| CN 205860622 U | 04-01-2017 | NONE | |
| KR 20180049670 A | 11-05-2018 | NONE | |
| WO 2019101000 A1 | 31-05-2019 | AU 2018372734 A1 | 09-07-2020 |
| | | CA 3083017 A1 | 31-05-2019 |
| | | CN 107990616 A | 04-05-2018 |
| | | US 2020393187 A1 | 17-12-2020 |
| | | WO 2019101000 A1 | 31-05-2019 |
| US 2006179869 A1 | 17-08-2006 | CN 1598451 A | 23-03-2005 |
| | | EP 1517102 A2 | 23-03-2005 |
| | | JP 4499437 B2 | 07-07-2010 |
| | | JP 2005090936 A | 07-04-2005 |
| | | KR 20050028658 A | 23-03-2005 |
| | | US 2005061016 A1 | 24-03-2005 |
| | | US 2006179869 A1 | 17-08-2006 |
| | | US 2007186576 A1 | 16-08-2007 |
| | | US 2008209938 A1 | 04-09-2008 |
| | | US 2008236188 A1 | 02-10-2008 |
| | | US 2010199702 A1 | 12-08-2010 |
| | | US 2011107785 A1 | 12-05-2011 |
| | | US 2011113811 A1 | 19-05-2011 |
| | | US 2011113812 A1 | 19-05-2011 |
| | | US 2011113813 A1 | 19-05-2011 |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82